

Transfer of patients with heart rate disorders for radiofrequency ablation and a five-year follow-up

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Acronyms

AV: atrioventricular

RFA: radiofrequency ablation

ECG: electrocardiogram

CAVB: complete AV block

PM: pacemaker

AVNRT: AV nodal reentrant tachycardia

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ABSTRACT

Introduction: The possibility to locate structures involved in arrhythmias with the use of catheter electrodes gave an impetus to the development of techniques linked to the selective destruction of cardiac tissue. This is possible through radiofrequency catheter ablation. These procedures are the first choice treatment for most cardiac arrhythmias. The objective was to characterize clinically the pre and post therapeutic procedure for patients transferred to receive radiofrequency ablation.

Method: A prospective and descriptive study in 26 patients with heart rhythm disorders who were referred for radiofrequency ablation and followed up for five years at the Cardiology Outpatient Department of the Dr. Gustavo Aldereguía Lima Hospital, in Cienfuegos. The variables studied were age, sex, type of clinical arrhythmia, arrhythmogenic substrate ablated, complications, initial success and recurrence of the treated arrhythmia.

Results: The mean age of patients was 40.9 ± 17.6 years, mostly women (57.7%). Younger patients (mean age 38.6 ± 19.7 years) were treated for atrioventricular nodal reentrant tachycardia and older patients (mean age 53.4 ± 23 years) underwent a non-selective ablation of the atrioventricular node. Half of the patients had orthodromic tachycardia; therefore, the most commonly treated arrhythmogenic substrate was an accessory pathway (65.4%). There were two major complications (7.7%), none of them directly related to the application of radiofrequency energy. In two patients (9.1%), the previously treated clinical arrhythmia recurred during the first year; both of them had right accessory pathways.

Conclusions: It was feasible to transfer patients for radiofrequency ablation because of agreements with two centers which conduct the procedure. Most of them had tachyarrhythmias involving accessory pathways. Only two major complications occurred; the initial success rate was adequate and the recurrence rate of the arrhythmia was small.

Key words: Catheter Ablation; Radiofrequency; Cardiac Arrhythmias

Transferencia de pacientes con trastornos del ritmo cardíaco para ablación con radiofrecuencia y su seguimiento durante cinco años

RESUMEN

Introducción: La posibilidad de localizar, con catéteres-electrodos, las estructuras que intervienen en las arritmias, propiciaron el ímpetu para el desarrollo de técnicas que tuvieran que ver con la destrucción selectiva del tejido cardíaco. Ello es posible mediante la ablación con catéter de radiofrecuencia. Estos procedimientos constituyen la opción terapéutica de primera elección para la mayoría de las arritmias cardíacas. El objetivo fue caracterizar clínicamente el pre y post procedimiento terapéutico a pacientes transferidos para ablación con radiofrecuencia.

Método: Estudio descriptivo, prospectivo, en 26 pacientes con trastornos del ritmo cardíaco, enviados para ablación con radiofrecuencia, seguidos en consulta externa durante cinco años en el Servicio de Cardiología del Hospital "Dr. Gustavo Aldereguía Lima", Cienfuegos. Las variables estudiadas fueron: edad, sexo, tipo de arritmia clínica presentada, sustrato arritmogénico ablacionado, complicaciones, éxito inicial y recurrencias de la arritmia tratada.

Resultados: La edad media de los pacientes fue de $40,9 \pm 17,6$ años, mayoritariamente mujeres (57,7 %). A los pacientes más jóvenes (edad media $38,6 \pm 19,7$ años) se les trató una taquicardia por reentrada intranodal y a los de mayor edad (media $53,4 \pm 23$ años) se les ablacionó de forma no selectiva el nodo aurículo-ventricular. La mitad de los pacientes presentaban una taquicardia ortodrómica de ahí que, el sustrato arritmogénico más tratado fue una vía accesorio (65,4 %). Ocurrieron dos complicaciones mayores (7,7 %), ninguna directamente relacionada con la aplicación de la energía de radiofrecuencia. En dos pacientes (9,1 %) la arritmia clínica previamente tratada recurrió durante el primer año, ambos tenían vías accesorias derechas.

Conclusiones: Fue factible transferir pacientes para ablación con radiofrecuencia debido a convenios de trabajo con dos centros ejecutores. La mayor parte presentaban taquiarritmias que involucraban vías accesorias. Solo se presentaron dos complicaciones mayores, el porcentaje de éxito inicial fue adecuado y el de recurrencia de la arritmia fue pequeño.

Palabras clave: Ablación por Catéter; Radiofrecuencia; Arritmias Cardíacas

INTRODUCTION

The knowledge about the critical role played by certain structures like the atrioventricular (AV) node, accessory pathways and the His-Purkinje system in the genesis and perpetuation of cardiac arrhythmias, and the possibility of locating these structures with intracardiac catheter electrodes, led to the development of techniques for the selective destruction of heart tissue. This is possible now by radiofrequency catheter ablation, which is carried out in an electrophysiology laboratory^{1,2}.

On one hand, the radiofrequency catheter procedures have emerged as the treatment of choice for most clinically significant cardiac arrhythmias, and have replaced antiarrhythmic drugs. On the other hand, the information obtained from several studies on the technique has greatly contributed to under-

standing the electrophysiological mechanisms of various cardiac arrhythmias, allowing a definitive treatment of disorders that previously were difficult to control^{1,3}.

Radiofrequency ablation (RFA) is then a fully established therapy in Cardiology. Its advantages include symptomatic relief, improvement of the functional capacity and quality of life, and the elimination of long-term use of antiarrhythmic drugs, with its potential adverse effects and high costs. The main disadvantage is the risk of complications, which depend on the ablative procedure and the operator's experience. Therefore, the risk-benefit ratio for RFA must always be considered in the individual patient^{1,2}.

The available data on the outcome of radiofrequency catheter ablation procedures in the world is not homogeneous. The most complete information

comes from the North American Society of Pacing and Electrophysiology⁴. In Europe, the Spanish registry is noteworthy, with reports that provide information on the results of RFA in relation to the substrates or treated arrhythmic mechanisms, efficacy, complications, comparisons with previous records, as well as the material and human resources of all centers that perform the procedure in that country⁵. Unfortunately most of the registries only include the immediate results, that is, instant success based on the ultimate electrophysiological objectives of the procedure; and, as it is well known, these results may be better than the long-term clinical success⁶.

In our country, most of the experience in the procedure is at Clinical Electrophysiology Group of the Institute of Cardiology and Cardiovascular Surgery in Havana^{7,8}. Additionally, the Department of Cardiac Electrophysiology and Pacing of the Cardiocentro "Ernesto Che Guevara" in Santa Clara also has a significant experience. We have working relations with both groups and have transferred patients in need of this procedure to them.

The aim of this study was to characterize clinically the pre and post therapeutic procedure for patients transferred to receive RFA.

METHOD

Patients and setting

A total of 26 patients were included; 22 were treated at the Arrhythmia Office of the Cardiology Outpatient Department and 4 admitted to the Cardiac Comprehensive Care Unit of the Dr. Gustavo Alde-reguía Lima Hospital in Cienfuegos. These patients were referred to the Institute of Cardiology and Cardiovascular Surgery in Havana or to the Cardiocentro "Ernesto Che Guevara" in Santa Clara to undergo RFA during the years 2000 to 2006. All of them had symptomatic arrhythmias. Some of them were arrhythmias refractory to drug treatment, and others presented difficulties with the adherence to the treatment aimed at preventing recurrences, or with serious adverse or uncomfortable effects for the patient, who preferred the ablation option. Another group had highly dangerous arrhythmias. The general features of the procedure, benefits and potential risks were explained to all of them, and informed consent was obtained by the center performing the procedure.

Only one patient had structural heart disease as assessed by echocardiogram.

Study Design: Descriptive, case series.

Procedure

The medical records of the 26 patients were analyzed, as well as the counter-referral document sent by the center performing the procedure. The variables studied were: age, sex, type of specific clinical arrhythmia, substrate (or arrhythmogenic mechanism ablated), complications during the procedure, immediate success (or failure) of the procedure and the possibility of recurrence of the treated arrhythmia during a five-year follow-up.

The specific type of clinical arrhythmia was considered first, by analyzing the 12-lead surface electrocardiogram (ECG), assessed by at least two independent observers; and then, based on the results of the electrophysiological study in the cases that it preceded ablative procedure (most of the cases), these results were recorded in a counter-referral document sent by the performing center. If there was no agreement between the two diagnoses, it was assumed the type of arrhythmia diagnosed by the electrophysiological study.

The arrhythmogenic substrate was defined (as reflected in the document sent by the performing center) in four categories: accessory pathways (classified as left and right); AV node for non-selective ablation and production of a complete AV block (CAVB); AV node for selective ablation and elimination of the intranodal reentry (without specifying the addressed pathway); and idiopathic fascicular ventricular tachycardia.

The different complications arising during the procedure were recorded in the counter-referral document sent by the performing center, and they were later classified by the author as major or minor complications according to the Sixth Report of the Spanish Registry of catheter ablation⁵. In turn, the minor complications were considered as transient ones if they disappeared during the first month of monitoring.

Initial or immediate success was assumed based on the results of the electrophysiological protocols of each center (contained in the counter-reference document), and were classified as successful or unsuccessful result.

Patients were followed up at the Outpatient Arrhythmia Office, monthly, during the first three months. Then quarterly, until completing one year of follow-up, and then every six months for five years.

Recurrence was assumed when:

- After the initial success, the patient reported paroxysms of palpitations and showed the same tachyarrhythmia he had before ablation, demonstrated on a 12 lead surface ECG, requiring health care, needing (or not) anti-arrhythmic drugs to avoid recurrences.
- Preexcitation reappeared on ECG, if the ablated substrate was a manifest accessory pathway.
- The patient was not always dependent on the pacemaker (PM), in case of non-selective ablation of the AV node to produce CAVB.

The variables studied were collected on a form prepared for this purpose, entered into a database and processed using the SPSS 15.0 for Windows. Tables were compiled, and summary measures such as percentage and arithmetic mean were used.

RESULTS

The average age of the series was 40.9 ± 17.6 years (Table 1). Most of the patients were female (57.7 vs. 42.3%), with a mean age equal for both sexes (42.3 years), although there was more variability of age among women ($SD \pm 18.5$ years vs. 13.8 in men). Generally, in the older patients (mean 53.4 ± 23 years), the AV node was treated in a non-selective way (to cause a CAVB, implant a PM and control ventricular rate), and younger patients (mean age 38, 6 years, $SD \pm 19.7$) received a selective ablation of the AV node

Table 1. General characteristics of the series.
Department of Cardiology, Gustavo Aldereguía Lima Hospital. Cienfuegos, 2000-2006.

Variable	Measure
Age (years, mean \pm SD)	$40,9 \pm 17,6$
Sex (%)	
Male	42,3
Female	57,7
Age /sex (years, mean \pm SD)	
Male	$42,3 \pm 13,8$
Female	$42,3 \pm 18,5$
Age /substrate of ablation (years, mean \pm SD)	
Accessory pathway	$40,2 \pm 13,6$
AV node (selective ablation)	$38,6 \pm 19,7$
AV node (non-selective ablation)	$53,4 \pm 23$

to cure atrioventricular nodal reentrant tachycardia (AVNRT).

Half of the patients (13) had orthodromic tachycardia, that is, paroxysmal supraventricular tachycardia involving an accessory pathway as a retrograde limb of AV reentry, regardless it was manifest or not on the surface ECG in sinus rhythm. It is noteworthy that 4 patients (15.4%) presented with atrial fibrillation (AF) conducted to the ventricles via an accessory pathway, a very dangerous arrhythmia (Table 2).

Table 2. Type of clinical arrhythmia in patients referred for RFA.

Type of clinical arrhythmia	Nº	%
Orthodromic tachycardia	13	50,0
Chronic AF with rapid ventricular response	4	15,4
AF with anterograde conduction by accessory pathway	4	15,4
Intranodal reentry	3	11,5
Incessant atrial tachycardia	1	11,5
Idiopathic ventricular tachycardia	1	3,8
Total	26	100,0

Table 3. Substrates or arrhythmogenic mechanisms in patients referred for RFA.

Sustrate or arrhythmogenic mechanism	Nº	%
Accessory pathway	17	65,4
AV node (non-selective ablation)	5	19,2
AV node (selective ablation)	3	11,5
Idiopathic fascicular VT	1	3,8
Total	26	100,0

Table 3 shows that the most treated substrate (65.4%) was an AV accessory pathway (bundle of Kent), followed, with a marked difference, by non-selective ablation of the AV node (19.2%). Accessory pathways ablation was performed more frequently in male patients (58.8%), while the AV node ablation (both selective and non-selective ablation) was performed only in women (Table 4).

Table 4. Substrates or arrhythmogenic mechanisms in patients referred for RFA, by sex.

Sustrate	Male		Female		Total	
	Nº	%	Nº	%	Nº	%
Accessory pathway	10	58,8	7	41,2	17	100,0
AV node (non-selective ablation)	-	-	5	100,0	5	100,0
AV node (selective ablation)	-	-	3	100,0	3	100,0
Idiopathic fascicular VT	1	100,0	-	-	1	100,0
Total	11	42,3	15	57,7	26	100,0

Table 5. Complications in patients referred for RFA in relation to the treated substrate.

Complications		Type of Substrate treated			Total (n = 26)	
		Accessory pathway	AV node Selective	AV node Non-selective	Nº	%
Mild	First degree transient AV block	-	2	-	2	7,7
	Transient branch block	2	1	-	3	11,5
Major	Pneumothorax	1	-	-	1	3,8
	Pocket sepsis	-	-	1	1	3,8
Subtotal of major complications		1	-	1	2	7,7

Table 6. Treated substrates and their distribution according to initial success and recurrence of the arrhythmia during a 5-year follow-up, in patients referred for RFA.

Sustrato	Nº of patients	Initial success		Recurrences	
		Nº	%	Nº	%
Left accessory pathway	7	7	100,0	0	0,0
Right accessory pathway	8	6	75,0	2	33,3
More than one accessory pathway	2	1	50,0	0	0,0
Subtotal accessory pathway	17	14	82,4	2	14,3
AV node (selective ablation)	3	3	100,0	0	0,0
AV node (non-selective ablation)	5	5	100,0	0	0,0
Idiopathic fascicular VT	1	0	0,0	0	0,0
Total	26	22	84,6	2	9,1

Major complications occurred in two patients (7.7%) (Table 5); one of them related to a vascular access (pneumothorax), and the other appeared early during the follow-up (PM pocket sepsis).

Initial success was reported in 84.6% of patients (three failures in dealing with accessory pathways and

an unsuccessful attempt to cure idiopathic ventricular tachycardia). In the most ablated substrate (accessory pathways), initial success was achieved in 82.4% of patients. However, two patients who underwent treatment of an accessory pathway (both of right location) had recurrence of the same clinic arrhythmia

during the follow-up (Table 6).

DISCUSSION

Cardiac arrhythmias occur in a wide clinical spectrum of patients, and in the presence or absence of structural heart disease. They may be episodic, inconsequential disorders, triggered by perfectly identifiable and correctable factors; however, they may also be major events that threaten the patient's life. There is no doubt that the existence of structural heart disease, especially in the ventricular function, influence the prognosis and therapeutic approach, but the identification of serious arrhythmogenic syndromes in anatomically normal hearts has increased. Anyway, arrhythmias affect the quality of life of patients and are a frequent reason for requiring health services, particularly in emergency departments.

The rapid rise of new technologies has facilitated the development of non-pharmacological options for coping with heart rhythm disorders, whether episodic, recurrent, incessant or chronic ones, and presenting a structural heart disease or not. One example is radio-frequency catheter ablation. The analysis of international records (which are few) does not allow us to estimate, at least directly, the number of people from the general population who may need ablation, but some authors infer that the number of ablations may increase if more patients were referred to electrophysiology laboratories⁶.

The accessory pathways, one of the most commonly treated substrates, are birth defects that occur in one of every thousand people¹, although not all patients develop symptomatic tachyarrhythmias. Obviously, the procedure is expensive, requires equipment and technology, trained personnel in high-volume centers, and all this is a problem to be faced by the developing countries. Cuba, that is proud of having a free health system, with national coverage, and for which the state provides a huge budget, makes efforts to continuously improve the services to the population. In this regard, in 1985, the National Group on Electrophysiology and Cardiac Pacing was created at the Institute of Cardiology and Cardiovascular Surgery. Since 1989, specialists were trained at this center, and in June 2003, the Arrhythmia Group was created at the Cardiocentro "Ernesto Che Guevara" in Santa Clara. The National Cardiology Network organizes the working relations between these centers and the provincial services of Cardiology.

In our province, the Cardiology Department offers a specialized cardiac arrhythmia consultation every week, attending patients discharged from the provincial hospital, and referred by specialists (mainly of Internal Medicine) from the municipalities and health areas of the provincial capital.

In this study, the arrhythmias were present almost exclusively in patients without structural heart disease (only one patient suffered from valvular aortic stenosis); even the patients with chronic AF only had the rhythm disorder. That is why the mean age of patients was higher in other series (for example, 53 years in the Sixth Report of the Spanish Registry and 50 years in an Argentine series)^{3,5}.

The clinical arrhythmias and the substrates treated are consistent with international reports, and show some differences. In a consecutive series of 1500 patients ablated at the Ignacio Chavez Institute of Cardiology in Mexico (from 1992 to 1999), 65.8% of the treated tachyarrhythmias involved accessory pathways¹²—a result that is identical to ours. In the Spanish registry, the accessory pathways ablated from 2001 to 2006 were the second most frequent cause (except in 2002 when they topped the list)⁵, and in the Argentine series cited above, they were the third cause³. In Spain, the AVNRT is the most treated one; it leads all reports that are published annually (except 2002)⁵. However, in our series, this arrhythmia, which is the most common of all paroxysmal supraventricular tachycardias, is ranked third, with a small number of patients. In any case, it is evident that the RFA has revolutionized the treatment of this type of tachycardias, whether they are generated by a reentry mechanism in the AV node or by the presence of an anomalous AV connection.

Another substrate frequently ablated in the international series checked is the cavo-tricuspid isthmus to cure common atrial flutter (third in all annual reports of the Spanish Registry⁵ and first in the Argentine series); however, it is not present in ours. We do not know the prevalence of the arrhythmia in our environment, but we can argue that the selection of patients based on a surface ECG, to be able to say that it is an arrhythmia dependent on that substrate, still has some difficulties for professionals that are not engaged in Arrhythmology. On the other hand, we have referred patients for RFA and they have not undergone the procedure because of the unavailability of the specific catheters in the centers that perform the

technique.

The AV node ablation to cause a CAVB is a frequently performed procedure in the series checked. It is ranked 5th and 6th in all reports of the Spanish Registry⁵. It is ranked 4th in the Mexican series¹² and 6th in the Argentine series. Although this procedure does not aim to cure the arrhythmia, it does enable an adequate control of ventricular rate and improves the quality of life of patients, and more importantly, prevents tachycardia-related cardiomyopathy. We emphasize these aspects because we think these concepts are not yet widespread in our environment, and there is a bit of indifference with regard to tachycardia in patients with frequent arrhythmias, such as chronic AF and rapid ventricular response. Direct ablation of AF, increasingly practiced in the world today, is almost limited to laboratories that have the latest technological advances, and is not performed in the centers to which we refer our patients¹⁰.

As for the distribution of the treated substrates by sex, our results coincide with other records where selective ablation of the AV node to cure AVNRT was more frequent in women, and ablation of ventricular tachycardia (VT) more frequent in men⁵.

RFA has been shown to be safe with low complication rates (2.4% in a literature review of several studies)². The most common ones are AV conduction disturbances, pericardial effusion with or without cardiac tamponade, and those related to vascular access². They depend on several factors, including the condition treated, presence or absence of structural heart disease and the experience and technological possibilities of the electrophysiologists. The CAVB is more common when addressing selectively the AV node and the transseptal accessory pathways^{2,9}. Recent reports give overall rates of complications of 1% in the Mexican series¹², 2.7% in the Argentine³ and 1.4% in the Sixth Report of the Spanish Registry. Ours is higher, despite being conventional substrates, but it is noteworthy that the major complications (pneumothorax and PM pocket sepsis) are not directly related to the use of radiofrequency energy, and are also potential risks in established clinical procedures such as deep venous approach and the implantation of permanent PM.

In relation to the substrate, the Spanish Registry annual reports from 2001 to 2006 show complication rates ranging from 0.9 to 2% in accessory pathways, from 0 to 1.7% in non-selective ablation of the AV

node, from 0.4 to 1.2% in selective ablation (AVNRT) and from 1.6 to 5.6% when addressing the VT⁵.

Initial studies of RFA reported no fatal complications². Later, investigations in five universities during the last decade, which gathered 3.856 patients, showed a fatality rate of 0.08%². The Sixth Report of the Spanish Registry showed an overall rate of fatal complications of 0.015%, and, considering the target substrate, it was 0.06% for the accessory pathways (one patient died of myocardial infarction associated with the procedure)⁵, while the annual risk of sudden death in patients with Wolff-Parkinson-White and symptomatic tachycardia, not treated with RFA, has been estimated between 0.05 and 0.5%². In our series there were no deaths.

The overall percentage of initial success of our series is lower than other international studies in spite of the fact that no patient with complex substrates was treated, as AF and VT in patients with structural heart disease. The series reviewed from the last decade show initial success rates exceeding 90%^{3,5,12}. Initial success depends primarily on the treated arrhythmogenic substrate. The initial success rate in the main substrate of our series, that is, accessory pathways, was also lower than in the international records of the last decade (that range from 89 to 93%)^{3,5,12}. Within this substrate, the location of the pathway influences the chances of success, being those of antero-septal and right location the most difficult ones to ablate⁹. In our series, failures were also reported in the right pathways.

On the other hand, the initial success achieved in AV node ablations, whether selective or not (although with small numbers of patients), were consistent with international reports^{5,12}. The attempt to cure idiopathic VT was unsuccessful. The reports on the treatment of this substrate, not addressed by many centers, show initial success rates between 63 and 80%^{5,13}.

Most international registries show initial success rates, but few include medium and long term clinical monitoring of patients, and the incidence of recurrence of the previously treated clinical arrhythmias, or new arrhythmias. The series of the Ignacio Chavez Institute of Cardiology in Mexico show an overall recurrence rate of 9.4%¹², similar to that observed in our patients. Most of the literature reviewed refers to recurrences specifically after ablation of accessory pathways, with percentages ranging from 3 to 9%^{2,12};

figures that are lower than the percentage of recurrences of the accessory pathways treated in our small series.

Recurrences only appeared in the right pathways, a finding that coincides with other authors^{1,2}. Therefore, patients with left accessory pathways would be better candidates for RFA; and if the pathway is evident, the polarity of the delta wave in sinus rhythm in lead V1 of the surface ECG helps locate it. The recovery of the conduction capacity of an accessory pathway after being ablated is because the injury caused by radiofrequency energy affects a peripheral zone (halo) of heart tissue that is damaged but viable and recovers with time¹. In the case of the right accessory pathways, there is the additional fact that they are anatomically wider than those in other location. Therefore, in many cases, in spite of applying radiofrequency in points with excellent electrograms, the interruption of the conduction through the bundle of Kent can be transient; hence there is a greater rate of recurrences^{1,2}.

CONCLUSIONS

It was feasible to refer patients for RFA because of the agreements and working relations with the two centers that perform the procedure. Most patients had tachyarrhythmias involving accessory pathways. Although it was a short series treating conventional substrates, only two major complications not directly related to radiofrequency energy were reported. The initial success rate was adequate, and two patients (both with right accessory pathways) had recurrence of the clinic arrhythmia during the follow-up period.

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